MODULE 1: CLIMATE CHANGE,THE ENVIRONMENT AND AGRICULTURE

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Overall Context

- Earth Summit
- Convention on Biological Diversity
- Climate Change Convention

Objective of Module

To highlight the value and importance of the environment.

Approach

An appreciation of the following is required:

- **structure of living things (biodiversity)**
- **nature of interaction between living organisms**
- **importance and functions of biodiversity**
- **changes impacting importance, functions and structure of biodiversity**
- **opportunities for protecting biodiversity**

Definition of Biodiversity

The variation of life at all levels of biological organization, inclusive of:

I. **genes,**

II. **species and**

III. **ecosystems or living parts of planet Earth from all sources (land, seas and other water bodies or aquatic systems)**

Classification of Biodiversity

- **on the basis of evolutionary ancestry(origin of life)**
- **on the basis of levels of diversity (genes, species, ecosystems)**
- **on the basis of large scale life zones of planet earth (where on earth's surface certain plant species are found most abundantly)**

Classification based on evolutionary ancestry (common ancestor)

- **All living organisms are derived from a common ancestor**

- **Primary level classification (Domains):** **Bacteria, Archaeabacteria, Eucaryotes.**

- **Secondary level classification (Kingdoms):** **Bacteria, Archaebacteria, Plants Fungi, Animals and Protists.**

Classification based on evolutionary ancestry

Characteristics of Domains and Kingdoms

- structure
- function

Bacteria and Archaeabacteria

- Archaeabacteria: occupy extreme environments with extreme conditions, eg high temperature, salinity and acidity
- Bacteria: extremely diverse with respect to habitat, function and products.

Plants, animals and fungi

- Have been domesticated to create modern agriculture.
- Provide other important services to mankind (will be discussed in more detail later)

Classification based on diversity

In this presentation, this classification points to resources available for agriculture and other benefits to mankind

- genetic diversity
- species diversity
- ecosystem diversity

Classification based on diversity

Genetic diversity

- **This refers to the variation of genes within populations, among populations and among species.**
- **Important in breeding and selection in agriculture. Give examples.**

Classification based on diversity

Species diversity

- This refers to the number of species and their relative abundance.
- Also important for agriculture and other services to mankind

Classification based on diversity

- Ecosystem diversity

  This refers to the difference in diversity among habitats in a given ecosystem, for example in a tropical rain forest.

Classification based on life zones

Classification of biological communities of the natural world on a large scale:

- Terrestrial biomes
- Aquatic biomes

Classification based on life zones

Characterization of terrestrial life zones.

- This is based on the dominant plant form in major geographical regions of planet earth.
- The distribution of the dominant plant forms is influenced mainly by **temperature** and **precipitation**.

Terrestrial Life Zones

- Boreal forest biome
- Tundra biome
- Deciduous forest biome
- Temperate needly-leafed biome
- Temperate rain forest biome
- Temperate grassland biome
- Mediterranean woodland biome
- Desert biome
- Tropical rain forest biome
- Tropical seasonal forest biome
- Tropical savannah biome

Terrestrial biomes

- Boreal forest biome: centered at about 50 degrees North in North America and 60 degrees North in Europe and Asia. It is characterized by low temperatures, moist soil, low levels of evaporation of moisture and vast stands of evergreen needle-like trees such as spruce and fir as the dominant plants.

Terrestrial biomes

- Tundra biome: located north of the Boreal biome in polar climate. The soil is permanently frozen and precipitation is low. The dominant plant forms are dwarf prostrate woody shrubs

Terrestrial biomes

- Deciduous forest biome: This is found in North America, mainly in the eastern part of the USA, southern Canada, Europe and eastern Asia. Precipitation exceeds evaporation and the dominant plant forms are deciduous trees with a sub-canopy of smaller trees.

Terrestrial biomes

- Temperate needly-leafed biome: This can be found in the coastal plains of the Atlantic zone of North America. The soil is mostly dry and the dominant plant form is pine. Fires are frequent and most species resist fire damage.

Temperate rain forest

- Temperate rain forest biome: This is located near the Pacific coast of north-western USA, British Columbia, Chile, New Zealand and Tasmania. These areas are characterized by mild winters, heavy rainfall and summer fog. Tall evergreen forest is the dominant vegetation and species diversity is low.

Terrestrial biomes

- Temperate grassland biome: This develops where rainfall is about 30-85 cm per year and can be found extensively in central Asia and in North America. The vegetation is dominated by grasses and herbaceous species. In North America extensive grasslands are referred to as prairies. The summers are hot and the winters are cold. Fire is a frequent occurrence in grasslands.

Terrestrial biomes

- Mediterranean woodland biome: This is distributed at 30-40 degrees latitude north and south of the equator. It is characterized by mild temperatures, winter rain and summer drought. The climate supports shabby vegetation with deep roots and drought resistant foliage

Terrestrial biomes

- Desert biome: This is characterized by low precipitation. Hot deserts are located near the equator and cold ones are to be found at high and middle latitudes.

Terrestrial biomes

- Tropical rain forest biome: This is characterized by persistent warm climates and high precipitation. The dominant vegetation are tall trees with epiphytes. Productivity and species diversity are greatest for this biome.

Terrestrial biomes

- Tropical seasonal biome: This develops beyond 10 degrees North and South of the equator. There is a pronounced dry season. The vegetation is mainly deciduous trees which shed their leaves during the dry spell

Terrestrial biomes

- Tropical savannah biome: This is characterized by grassland with scattered trees. It is present in areas of dry forest notably in Africa

Aquatic biomes

- Characterization of aquatic biomes: These are ocean and fresh water environments and are classified on the basis physical characteristics such as salinity, water movement, depth, etc. These biomes include streams, lakes , oceans, etc.

Value of biodiversity

- Economic benefits: food, fibre, building materials, drugs, cosmetics, raw materials for many industries, etc.
- Correct functioning and maintenance of environment and climates
- Landscaping, leisure and culture.

Value of biodiversity: food production

- Food contributions from naturally occurring and agro-ecosystems
- Value of genetic resources

Centres of origin for genetic resources

- Chinese centre
- Indo Malayan centre
- Indo Afgani-Central Asia centre
- Near East centre
- Mediterranean centre
- Abyssinian centre
- Mexico-Central America centre
- South American centre
- North American centre
- West African centre
- North European centre

Centres of origin of genetic resources

- Chinese centre: soybean, cucumber, sorghum, millet, yam, chinese cabbage, pak-choi, rapeseed, raddish
- Indo Malayan centre: egg plant, cucumber, mung bean, cowpea, taro, yam, rice
- Indochina and Malayan Archipelago: banana, breadfruit, coconut, sugarcane

Centres of origin of genetic resources

- Indo Afgani-Central Asia: garden pea, groad bean, mung bean, leaf mustard, onion, garlic, spinach, carrot, apple, chickpea, lentil
- Near East centre: lentil, lupin, barley, oat, wheat
- Mediterranean centre: celery, asparagus, beetroot, oilseed rape, cabbage, parsnip, pea, oat, wheat, olive

Centres of origin genetic resources

- Abyssinean centre: okra, watercress, cowpea, barley, coffee, sorghum
- Mexico-Central America centre: sweet pepper, chilli, pumpkin, sweet potato, lima bean, kidney bean, maize, tomato
- South American centre: sweet pepper, chilli, pumpkin, tomato, kidney bean, potato, peanut, cassava.

Centres of origin of genetic resources

- North American centre: sunflower
- West African centre: millet, sorghum
- North European centre: oat, rye

Centres of Origin and Domestication of Genetic Resources

- Central America
- South America
- China
- South East Asia
- Near East
- Africa

Centres of Origin

- **CentralAmerica:** maize, Amaranthus, Chenopodium, sage, kidney bean, lima bean, sweet potato, yam bean, cotton, papaya, avocado, guava, pear, chilli, black pepper, pumpkin, tomato, vanilla and cocoa.

Centres of Origin

- **South America:** Amaranthus, lima bean, Chenopodium, kidney bean, lupin, potato, Peruvian carrot, cassava, arrowroot, yam, peanut, cotton, cashew, pineapple, soursop, custard apple, Brazilian nut, guava, chilli, black pepper and pumpkin.

Centres of Origin

- **China:** Asian rice, millet, soybean, turnip, yam, rapeseed, Chinese walnut, peach, chestnut, apricot, quince, loquat, quince, Chinese cabbage, ginger and ginseng.

Centres of Origin

- **South East Asia:** Asian rice, beans, yam, coconut, breadfruit, orange, tangerine, grapefruit, mango, banana, cucumber, nutmeg, eggplant and plantain.
- **Near East:** wheat, barley, oat, rye, chick pea, lentil, lupin, turnip, carrot, radish, olive, figs, date palm, almond, grapes, apple, pear, plum, onion, garlic and lettuce.

Centres of Origin

- **Africa:** African rice, millet, sorghum, cowpea, yam, oil palm, castor oil, kenaf, abobad, melon, okra, sesame, solanum and coffee.

Opportunities for protecting the enviromment and conserving biodiversity

- Convention on International Trade in Endangered Species.
- United Nations Convention on Laws of the Seas
- The Montreal Protocol on Substances that Deplete the Ozone Layer.
- The Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their disposal.
- The Convention on Biological Diversity.
- The Cartagena Protocol on Biosafety.
- The United Nations Convention to Combat Drought and Desertification.
- Paris Agreement on Climate Change.
- Basseterre Agreement (Regional, OECS)

Prognosis of overall climate change impact on Grenada by 2030

- Decrease in annual rainfall by 5.3 mm
- Increase in annual temperature by 1.0 C to 1.1 C.

The Grenada Greenhouse Gas Emission.

Overall greenhouse gas emissions

- Waste 93 %
- Agriculture 0.02 %
- Transport 3.0 &
- Residential and commercial sector 0.98 %

Agriculture Greenhouse Gas Emission in Grenada

- Nitrogen fertilizers: 75 %
- Manure: 6.2 %
- Livestock (fermentation): 18.6 %

Iterations for Climate Smart Agriculture

Considerations based on impact of declining rainfall and higher ambient temperatures

- Exploitation of renewable energy sources
- Drought resistant systems (water conservation and capture)
- Mixed crops systems
- Soil conservation and protection
- Landscape protection and restoration